

[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR part 25

[Docket No. ; Notice No.]

RIN

Revised Landing Gear Shock Absorption Test Requirements

AGENCY: Federal Aviation Administration, DOT.

ACTION: Notice of proposed rulemaking.

SUMMARY: This document proposes to revise the landing gear shock absorption test requirements of the Federal Aviation Regulations (FAR) for transport category airplanes by incorporating changes developed in cooperation with the Joint Aviation Authorities (JAA) of Europe and the U.S. and European aviation industry through the Aviation Rulemaking Advisory Committee (ARAC). This action is necessary because the increasing complexity of landing gear shock absorption systems and the improvements in other requirements concerning landing loads have rendered the current requirements inconsistent and outdated. In addition, differences between the current U.S. and European requirements impose unnecessary costs on airplane manufacturers. These proposals are intended to update the landing gear requirements to be consistent with other requirements, to reflect modern technology, and to achieve common requirements and language between

the requirements of the FAR and the Joint Aviation Requirements (JAR) of Europe without reducing the level of safety provided by the regulations and industry practices.

DATES: Comments must be received on or before [insert a date 120 days after the date of publication in the Federal Register]

ADDRESSES: Comments on this notice may be mailed in triplicate to: Federal Aviation Administration (FAA), Office of the Chief Counsel, Attention: Rules Docket (AGC-10), Docket No. , 800 Independence Avenue SW., Washington, DC 20591; or delivered in triplicate to: Room 915G, 800 Independence Avenue SW., Washington, DC 20591.

Comments delivered must be marked Docket No. . Comments may also be submitted electronically to nprmcmt@mail.hq.faa.gov. Comments may be examined in Room 915G weekdays, except Federal holidays, between 8:30 a.m. and 5:00 p.m. In addition, the FAA is maintaining an information docket of comments in the Transport Airplane Directorate (ANM-100), FAA, 1601 Lind Avenue SW., Renton, WA 98055-4056. Comments in the information docket may be examined weekdays, except Federal holidays, between 7:30 a.m. and 4:00 p.m.

FOR FURTHER INFORMATION CONTACT: James Haynes, Airframe and Propulsion Branch, ANM-112, Transport Airplane Directorate, Aircraft Certification Service, FAA, 1601 Lind Avenue, SW., Renton, WA 98055-4056; telephone (206) 227-2131.

SUPPLEMENTARY INFORMATION

Comments Invited

Interested persons are invited to participate in this proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to any environmental, energy, or economic impact that might result from adopting the proposals contained in this notice are invited. Substantive comments should be accompanied by cost estimates. Commenters should identify the regulatory docket or notice number and submit comments in triplicate to the Rules Docket address above. All comments received on or before the closing date for comments will be considered by the Administrator before taking action on this proposed rulemaking. The proposals contained in this notice may be changed in light of comments received. All comments received will be available in the Rules Docket, both before and after the comment period closing date, for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerning this rulemaking will be filed in the docket. Persons wishing the FAA to acknowledge receipt of their comments must submit with those comments a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. .". The postcard will be date/time stamped and returned to the commenter.

Availability of NPRM

An electronic copy of this document may be downloaded using a modem and suitable communications software from the FAA regulations section of the Fedworld

electronic bulletin board service (telephone: 703-321-3330), the Federal Register's electronic bulletin board service (telephone: 202-512-1661), or the FAA's Aviation Rulemaking Advisory Committee Bulletin Board service (telephone: 202-267-5948).

Internet users may reach the FAA's web page at <http://www.faa.gov> or the Federal Register's web page at http://www.access.gpo.gov/su_docs for access to recently published rulemaking documents.

Any person may obtain a copy of this notice by submitting a request to the Federal Aviation Administration, Office of Rulemaking, ARM-1, 800 Independence Avenue SW., Washington, DC 20591; or by calling (202) 267-9680. Communications must identify the notice number of this NPRM. Persons interested in being placed on a mailing list for future rulemaking documents should also request a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

Background

The manufacturing, marketing and certification of transport airplanes is increasingly an international endeavor. In order for U. S. manufacturers to export transport airplanes to other countries the airplane must be designed to comply, not only with the U.S. airworthiness requirements for transport airplanes (14 CFR part 25), but also with the transport airworthiness requirements of the countries to which the airplane is to be exported.

The European countries have developed a common airworthiness code for transport airplanes that is administered by the Joint Aviation Authorities (JAA) of Europe. This code is the result of a European effort to harmonize the various airworthiness codes of the European countries and is called the Joint Aviation Requirements (JAR)-25. It was developed in a format similar to part 25. Many other countries have airworthiness codes that are aligned closely to part 25 or to JAR-25, or they use these codes directly for their own certification purposes.

The Aviation Rulemaking Advisory Committee (ARAC) was established by the FAA on February 15, 1991, with the purpose of providing information, advice, and recommendations to be considered in rulemaking activities. By notice in the Federal Register (59 FR 30081, June 10, 1994), the FAA assigned several new tasks to an ARAC working group of industry and government structural loads specialists from Europe, the United States, and Canada. Task 6 of this charter concerned the shock absorption test requirements for landing gear. The ARAC working group has completed its work for this task and the ARAC has made recommendations to the FAA by letter dated

Although the requirements for landing gear shock absorption tests are essentially the same between the FAR and JAR, the requirements do not address the capabilities of modern technology and do not take into account other related changes in the requirements for landing gear load conditions that have already been incorporated into other sections of the FAR. When the landing loads requirements for transport airplanes were originally

developed, they required the landing load factors to be determined and applied to the airplane. The airplane was treated as a rigid body and the landing loads were applied to this rigid representation of the airplane for the purpose of structural analysis. For the early landing gear systems, analysis alone, was considered sufficient for determining the landing load factor that would be applied to the rigid airplane. It was only necessary to determine the landing load factor (by analysis or tests) and this load factor would then be used to design and substantiate the airplane for the landing load conditions.

The development of more complex landing gear systems, for which analysis alone was unreliable, led to the adoption of a requirement to verify the landing load factor by actual shock absorption tests. This requirement was added to the Civil Aviation Regulations (CAR) part 4b that was the predecessor to part 25. These shock absorption tests were allowed by CAR 4b.200 to be free drop tests in which the gear alone, could be dropped in free fall to impact the ground. In these tests, mass is added to represent the proportion of the airplane weight on the landing gear unit, and the mass may be reduced to account to the effects of airplane lift acting during the landing impact. Later, the corresponding requirement in part 25, § 25.723(a), was modified to allow the substantiation of some changes to the landing gear shock absorption systems by analysis alone without verification by tests.

The current landing load requirements in part 25 require the landing loads to be determined accounting for the dynamic flexible airplane. In addition, the landing gear shock absorption systems have become even more sophisticated. At the same time, the

ability to develop highly sophisticated computer models of landing gear and airplane structures has also improved. In order to determine the airplane loads from the landing load conditions, it is no longer sufficient to determine just the load factor from a drop test of a landing gear unit. A comprehensive analysis of the combined dynamic systems for the landing gear and airplane are essential in order to determine the structural design loads for the airplane. In developing this dynamic model, it is necessary to provide an accurate representation of all the landing gear dynamic characteristics. This includes the energy absorption characteristics and the time histories of force and displacement during a landing impact. The current §§ 25.473(d) and 25.723(a) for shock absorption tests requires just the determination of the limit landing load factor from the drop test.

Discussion

The proposed revisions to §§ 25.473(d) and 25.723(a) would provide for the new objective of the landing gear energy absorption tests which would be to validate the landing gear dynamic characteristics rather than to directly determine landing gear load factors. These revisions would require that these characteristics be substantiated over the range of landing conditions and airplane configurations expected in service. The manufacturer would be expected to substantiate the landing gear dynamic characteristics over the full range of weight conditions and configurations. As a minimum, the energy absorption characteristics would be confirmed by an energy absorption test at the weight condition for landing (maximum takeoff weight or maximum landing weight) which provides the maximum impact energy. This is in contrast to the current §§ 25.473(d) and

25.723(a) that specifically require energy absorption tests at both the maximum landing weight condition and the maximum takeoff weight condition. The proposed rule would continue to provide for the substantiation of minor changes by analyses. To provide guidance in complying with the new proposed rule, a new Advisory Circular 25.723-1 is proposed.

The proposal for the revised §§ 25.473(d) and 25.723(a) takes into account the potential for sophisticated computer simulations that accurately represent the dynamic characteristics. It is also consistent with improvements in the landing load requirements that necessitate an accurate representation of the landing gear shock absorption characteristics. This proposal also provides more flexibility for the airplane manufacturer to determine the range of conditions and configurations over which to validate the analytical model for the landing conditions. The extent to which this analytical model could be extrapolated to include future design changes would depend on the range of conditions and configurations originally selected by the manufacturer for validation of the model.

The current §§ 25.725 and 25.727 are proposed to be deleted as regulatory requirements and would be set forth in the new proposed Advisory Circular 25.723-1. These criteria would be modified to reflect the advisory nature of the material as well as the revised objective of determining landing gear dynamic characteristics instead of landing gear limit inertia load factors. For the most part, these rules currently provide acceptable means of conducting energy absorption tests by means of a drop test. Section

25.725 provides an acceptable means of conducting a limit drop test for compliance with §§ 25.723(a), and 25.727 provides an acceptable means of conducting a reserve energy drop test in compliance with § 25.723(b). Most of the guidance is limited to a "free" drop test in which a reduced effective weight is used to represent lift during the landing impact. The only item in these two sections that is considered to be regulatory in nature is the current § 25.725(c) concerning the attitude of the landing gear and the representation of drag loads during the tests. Therefore this paragraph has been modified to apply to all types of landing gear energy absorption tests (not just drop tests) and it is now set forth in § 25.723(a)(2) of the proposed rule.

Regulatory Evaluation Summary

Regulatory Evaluation Summary, Regulatory Flexibility Determination, and Trade Impact Assessment

Changes to federal regulations must undergo several economic analyses. First, Executive Order 12866 directs Federal agencies to promulgate new regulations or modify existing regulations only if the potential benefits to society outweigh the potential costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities. Finally, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. In conducting these assessments, the FAA has determined that this proposed rule: (1) would generate benefits exceeding its costs and is not "significant" as defined in Executive Order 12866; (2) is not "significant" as defined in DOT's Policies and Procedures; (3)

would not have a significant impact on a substantial number of small entities; and (4) would lessen restraints on international trade. These analyses, available in the docket, are summarized below.

Regulatory Evaluation Summary

The proposed requirements, applicable to future type certificated transport category airplanes, would result in two regulatory changes: (1) utilizing landing gear energy absorption tests to validate the landing gear dynamic characteristics rather than the limit load factor value, and (2) confirming energy absorption characteristics by requiring tests at either the maximum landing weight or maximum takeoff weight condition, whichever provides the maximum landing impact energy. This is in contrast to current requirements which requires tests at both weight conditions.

The test results would be used to develop the analytical modeling of the landing gear dynamic characteristics. These regulatory changes would not result in any physical change in the way landing gears are tested: the attitude of the gear being usually simulated directly by orienting the gear on the rig and drags loads being applied by spinning the wheel up to the ground speed. Therefore, it would not impose additional costs on manufacturers. This was confirmed by two manufacturers.

Significant cost savings may result from not having to test both at maximum landing weight and maximum takeoff weight, but instead, conducting shock absorption tests only for the conditions associated with maximum energy. One manufacturer

estimates that this would result in 15 fewer test conditions per airplane certification. At a cost of \$5,000 per condition, the total cost savings would reach \$75,000 per airplane certification. Another manufacturer estimates a cost savings of approximately \$190,000 for a ten-year period.

Additionally, by harmonizing the standards of the FAR and JAR, the proposed rule would yield cost savings by eliminating duplicate certification activities.

Based on the finding of regulatory cost-savings, coupled with the cost-savings realizable from harmonization, the FAA has determined that the proposed rule would be cost-beneficial.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily or disproportionately burdened by government regulations. The RFA requires a Regulatory Flexibility Analysis if a proposed rule would have "a significant economic impact, either detrimental or beneficial, on a substantial number of small entities." FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, establishes threshold cost values and small entity size standards for complying with RFA review requirements in FAA rulemaking actions. The Order defines "small entities" in terms of size thresholds, "significant economic impact" in terms of annualized cost thresholds, and "substantial number" as a number which is not less than eleven and which is more than one-third of the small entities subject to the proposed or final rule.

The proposed rule would affect manufacturers of transport category airplanes produced under future new airplane type certifications. For airplane manufacturers, FAA Order 2100.14A specifies a size threshold for classification as a small manufacturer as 75 or fewer employees. Since no part 25 airplane manufacturer has 75 or fewer employees, the proposed rule would not have a significant economic impact on a substantial number of small airplane manufacturers.

International Trade Impact Assessment

The proposed rule would have no adverse impact on trade opportunities for U.S. manufacturers selling airplanes in foreign markets and foreign manufacturers selling airplanes in the U.S. market. Instead, by harmonizing the standards of the FAR and the JAR, it would lessen restraints on trade.

Federalism Implications

The regulations proposed herein would not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. Thus, in accordance with Executive Order 12612, it is determined that this proposal does not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

International Compatibility

The FAA has reviewed corresponding International Civil Aviation Organization regulations and Joint Airworthiness Authority regulations, where they exist, and have identified no differences in these proposed amendments and the foreign regulations.

Conclusion

Because the proposed changes to the landing gear shock absorption test requirements are not expected to result in any substantial economic costs, the FAA has determined that this proposed regulation would not be significant under Executive Order 12866. Because this is an issue that has not prompted a great deal of public concern, the FAA has determined that this action is not significant under DOT Regulatory Policies and Procedures (44 FR 11034; February 25, 1979). In addition, since there are no small entities affected by this rulemaking, the FAA certifies that the rule, if promulgated, would not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act, since none would be affected. A copy of the regulatory evaluation prepared for this project may be examined in the Rules Docket or obtained from the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

List of Subjects in 14 CFR part 25

Air transportation, Aircraft, Aviation safety, Safety.

The Proposed Amendments

Accordingly, the Federal Aviation Administration (FAA) proposes to amend 14 CFR part 25 as follows:

PART 25 - AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

1. The authority citation for Part 25 is revised to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

2. Section 25.473 is amended by revising paragraph (d) to read as follows:

§ 25.473 Landing load conditions and assumptions.

* * * * *

(d) The landing gear dynamic characteristics must be validated by tests as defined in § 25.723(a).

* * * * *

3. Section 25.723 is amended by revising paragraph (a) to read as follows:

§ 25.723 Shock absorption tests.

(a) Except as provided in § 25.723(a)(3), the landing gear dynamic characteristics used for design must be validated by energy absorption tests. The dynamic characteristics must be substantiated for the range of landing conditions, airplane configurations, and service variations expected in operation.

(1) The configurations subjected to energy absorption tests must include at least the maximum landing weight or the maximum takeoff weight, whichever produces the greater value of landing impact energy.

(2) The test attitude of the landing gear unit and the application of appropriate drag loads during the test must simulate the airplane landing conditions in a manner consistent with the development of rational or conservative limit loads.

(3) Changes in previously approved design weights and minor changes in design may be substantiated by analyses based on previous tests conducted on the same basic landing gear system that has similar energy absorption characteristics.

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§ 25.725 [RESERVED]

3. By removing § 25.725 and marking it reserved.

§ 25.727 [RESERVED]

4. B removing § 25.727 and marking it reserved.

Issued in Washington D.C. on

Record of Changes:

March 10, 1995

First Draft (Jim Haynes)

September 19, 1995

Revised to add 25.473(d) per WG meeting in toronto.

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TRANSFERRED TO:

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revised 10-18-95 (JT editorial changes)

revised 10-30-95 (NS edits)

revised 1-11-96 (DA, ANM-7 edits)

revised 5-9-96 (add regulatory evaluation summary, and new boilerplate information)

revised 5-14-96 (minor edit on page 6)